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SYMPOSIUM

Glycemia Prediction in Critically Ill Patients Using an Adaptive Modeling Approach

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Abstract

Background:

Strict blood glucose control by applying nurse-driven protocols is common nowadays in intensive care units (ICUs). Implementation of a predictive control system can potentially reduce the workload for medical staff but requires a model for accurately predicting the glycemia signal within a certain time horizon.

Methods:

GlucoDay (A. Menarini Diagnostics, Italy) data coming from 19 critically ill patients (from a surgical ICU) are used to estimate the *initial* ICU "minimal" model (based on data of the first 24 hours) and to *reestimate* the model as new measurements are obtained. The reestimation is performed every hour or every 4 hours. For both approaches the optimal size of the data set for each reestimation is determined.

Results:

The prediction error that is obtained when applying the 1-hour reestimation strategy is significantly smaller than when the model is reestimated only every 4 hours ($p < 0.001$). The optimal size of the data set to be considered in each reestimation process of the ICU minimal model is found to be 4 hours. The obtained average "mean percentage error" is 7.6% (SD 3.1%) and 14.6% (SD 7.0%) when the model is reestimated every hour and 4 hours, respectively.

Conclusions:

Implementation of the ICU minimal model in the appropriate reestimation process results in clinically acceptable prediction errors. Therefore, the model is able to predict glycemia trends of patients admitted to the surgical ICU and can potentially be used in a predictive control system.

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Abbreviations: (BIT) back-in-time, (ICU) intensive care unit, (ICU-MM) intensive care unit–minimal model, (IVGTT) intravenous glucose tolerance test, (MPE) mean percentage error, (MSE) mean squared error, (N-LSQ) nonlinear least squares

Keywords: glycemia prediction, intensive care unit, minimal model, parameter estimation, physical models

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